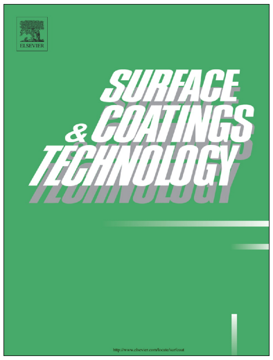

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Molecularly Grafted, Structurally Integrated Multifunctional Polymer Thin Films with Improved Adhesion

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Abstract

New advanced applications for flexible electronics and sensors require novel materials with multifunctional properties. Such engineered thin films find applications in structurally integrated batteries and sensors that can carry mechanical loads in addition to performing energy conversion functions. One example is poly(3,4-ethylenedioxythiophene) (PEDOT) thin films which are electrically conducting with good mechanical stability. Normally, organic thin film materials are loosely anchored to surfaces by weak physical interactions like Van der Waals forces or physisorption. In order to improve the generally poor adhesion of such polymer films, a novel molecular scale grafting technique using chemical vapor deposition (CVD) polymerization was utilized. Using a stressed overlayer, the adhesion energy of PEDOT films on Si with and without a graft was evaluated. It was found that the addition of a graft qualitatively and quantitatively improves adhesion of PEDOT to the substrate surface. Films without the graft delaminated spontaneously and areas of the film spalled off the Si substrate after the application of Molybdenum stressed overlayer. Similar PEDOT films with the graft only spontaneously delaminated after the same stressed overlayer was added. From the spontaneous buckling, the adhesion energy of the PEDOT-Si interface can be determined using the well-known Hutchinson and Suo model. Adhesion energies were compared to calculate bonding strength to potentially identify the failing bonds.

Keywords

Adhesion; Thin films; Stressed overlayer; Conducting polymers; CVD; Molybdenum